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C-A OPERATIONS PROCEDURES MANUAL

15.5.15 Install/Remove Thermocouple Gauge

(Vacuum Group Procedure VA-008-18.1.15)

Note: This document was formerly a C-A Group Procedure. The content of the group procedure was reviewed by the Technical Supervisor. All approvals and/or issue dates of the original group procedure are maintained for present use.

Hand Processed Changes

<u>HPC No.</u>	<u>Date</u>	<u>Page Nos.</u>	<u>Initials</u>
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Approved: _____
Signature on File
Collider-Accelerator Department Chairman

Date

S. Gill

Vacuum Group Procedure VA-008.18.1.15
Original Issue Date: 01/01/00
Revision 01

****IMPORTANT****

PRIOR TO THE PERFORMANCE OF ANY WORK WITHIN THE SCOPE OF THIS PROCEDURE, IT IS THE RESPONSIBILITY OF THE SUPERVISOR TO ENSURE THAT ***WORK PLANNING*** HAS BEEN REVIEWED FOR THE PROTECTION OF WORKERS, EQUIPMENT, AND THE ENVIRONMENT.

1.0 PURPOSE:

- 1.1 TO PROVIDE AN EFFECTIVE PROCEDURE FOR AGS VACUUM TECHNICIANS TO SUCCESSFULLY INSTALL & OR REMOVE A THERMOCOUPLE GAUGE.

2.0 RESPONSIBILITIES:

- 2.1 THE AGS VACUUM SUPERVISOR SHALL BE RESPONSIBLE FOR THE IMPLEMENTATION OF THIS PROCEDURE.

3.0 DISCUSSION:

- 3.1 THIS PROCEDURE IS WRITTEN SO THAT TRAINED AGS VACUUM TECHNICIANS WILL BE ABLE TO SUCCESSFULLY AND EFFICIENTLY INSTALL AND/OR REMOVE A THERMOCOUPLE GAUGE IN THE RING OR ON TEST EQUIPMENT OUTSIDE THE RING ENCLOSURES.

4.0 PRECAUTIONS:

- 4.1 THE TECHNICIAN SHALL BE AWARE OF RADIATION LEVELS IN THE AREA AND, WHERE REQUIRED, SHALL OBTAIN A RADIATION WORK PERMIT.
- 4.2 THE TECHNICIAN WILL ENSURE THAT HE IS IN FACT USING A SAFE AND PROPERLY FUNCTIONING GAS REGULATOR AND BOTTLE CART. THOSE FOUND TO BE UNSAFE SHALL BE RETURNED FOR REPAIR.
- 4.3 THE TECHNICIAN SHOULD BE AWARE OF WHAT CONSTITUTES A VACUUM SECTOR. FOR EXAMPLPE, SECTOR 'AB' STARTS AT A14 AND ENDS AT THE B3 MAIN MAGNET. SECTOR 'B' STARTS AT B4 AND ENDS AT THE B13 MAIN MAGNET. A SCHEMATIC REPRESENTING THE ENTIRE AGS LAYOUT IS POSTED IN THE VACUUM LAB.
- 4.4 CHECK COLOR CODE ON KIRK KEY & VERIFY THAT IT MATCHES THAT OF THE HV CABLES IN THE LOCKED OUT SECTOR.

5.0 PREREQUISITES:

- 5.1 THE TECHNICIAN WILL HAVE BEEN TRAINED IN THIS PROCEDURE.
- 5.2 LOCKOUTITAGOUT 15.17.00.02
- 5.3 ELECTRICAL SAFETY 15.17.00.04
- 5.4 AGS RING ACCESS TRAINING.
- 5.5 ACTIVATION WORKER TRAINING (BNL OH&S GUIDE 3.5.0)
- 5.6 SAFETY GLASSES ARE REQUIRED FOR THIS PROCEDURE
- 5.7 TECHNICIAN HAS BEEN TRAINED TO AT LEAST A LEVEL OF KNOWLEDGEABLE IN LOITO AGSIHEBT VACUUM ION PUMP POWER DISCONNECT
- 5.8 AFFECTED PERSONS TRAINING 15.12.00.01

6.0 OPERATIONAL PROCEDURE:

- 6.1 ENSURE THAT A RADIATION SURVEY HAS BEEN DONE BY THE HP PEOPLE OF THE AREA TO BE WORKED IN.
- 6.2 CLOSE SECTOR VALVES AND DISCONNECT POWER TO THOSE

- VALVES *UIS* AND *DIS* OF SECTOR TO BE VENTED.
- 6.3 PERFORM LOITO PROCEDURES FOR ION PUMP HV SUPPLIES)
 - 6.4 PERFORM LOITO PROCEDURES FOR SECTOR CCG.
 - 6.5 AFFIX N2 HOSE TO SMALL HAND VALVE ON SECTOR B.T.A. VALVE.
 - 6.6 SET REGULATOR TO APPX.2 PSIG & VERIFY THAT THE OVER PRESSURE RELIEF VALVE OPENS FREELY.
 - 6.7 OPEN B.T.A. VALVE & VENT SECTOR TO ATMOSPHERE.
 - 6.8 WHEN SECTOR REACHES A TMOS. PRESSURE, CLOSE N2 TANK VALVE & REMOVE HOSE.
 - 6.9 CLOSE B.T.A. VALVE & SMALL HAND VALVE.
 - 6.10 REPLACE AND / OR INSTALL THERMOCOUPLE GAUGE AS PER MANUFACTURER INSTRUCTIONS.
 - 6.11 PROCEDE WITH ROUGHING & LEAK CHECK PROCEDURE 8.18.1.20
 - 6.12 PROCEDE WITH SECTOR START-UP PROCEDURE 8.18.1.53

7.0 ACCEPTANCE CRITERIA:

- 7.1 SECTOR HAS BEEN VENTED, GAUGE REPLACED, AND VACUUM INTEGRITY RESTORED.

8.0 FINAL CONDITIONS:

- 8.1 WORK AREA HAS BEEN CLEANED AND ALL EQUIPMENT AND/OR TOOLS HAVE BEEN REMOVED FROM THE RING AFTER BEING CHECKED BY H-P PERSONNEL.
- 8.2 DOSIMETER READINGS HAVE BEEN LOGGED IN THE DOSIMETER LOG BOOK LOCATED IN THE VACUUM LAB. 8.3 VACUUM INTEGRITY RESTORED.

SECTION I

SAFETY INSTRUCTIONS

SAFETY PAYS. THINK BEFORE YOU ACT. UNDERSTAND WHAT YOU ARE GOING TO DO BEFORE YOU DO IT. READ THIS INSTRUCTION MANUAL BEFORE INSTALLING, USING, OR SERVICING THIS EQUIPMENT. IF YOU HAVE ANY DOUBTS ABOUT HOW TO USE THIS EQUIPMENT SAFELY, CONTACT THE GRANVILLE-PHILLIPS PRODUCT MANAGER FOR THIS EQUIPMENT AT THE ADDRESS LISTED ON THIS MANUAL.

Explosive Gases

Do not use the gauge tube to measure the pressure of combustible gas mixtures. The sensing element normally operates at only 125°C but it is possible that momentary transients or controller malfunction can raise the sensor above the ignition temperature of combustible mixtures which might then explode causing damage to equipment and injuring personnel.

High Pressure Operation

Do not use a compression mount (quick connect) for attaching the gauge tube to the system in applications resulting in positive pressures in the gauge tube. Positive pressures might blow the tube out of a compression fitting and damage equipment and injure personnel. The Series 275 gauge is not intended for use above 1000 Torr or 1333 mbar true pressure.

Tube Mounting Position

If the gauge tube will be used to measure pressures greater than 1 Torr or 1 mbar, the tube must be mounted with its axis horizontal. Although the gauge tube will read correctly below 1 Torr (or 1 mbar) when mounted in any position, erroneous readings will result at pressures above 1 Torr (or 1 mbar) if the tube axis is not horizontal. Erroneous readings can result in over or underpressure conditions which may damage equipment and injure personnel.

Overpressure

Series 275 gauges are not intended for use above 1000 Torr (1333 mbar) true pressure. Do not use above 1000 Torr (1333 mbar) true pressure. Series 275 instruments are furnished calibrated for N₂. They also measure the pressure of air correctly within the accuracy of the instrument. Do not attempt to use a Series 275 gauge calibrated for N₂ to measure or control the pressure of other gases such as argon or CO₂, unless accurate conversion data for N₂ to the other gas is properly used. If accurate conversion data is not used or improperly used, a potential overpressure explosion hazard can be created under certain conditions.

For example, at 760 Torr of argon gas pressure, the indicated pressure on a Series 275 gauge calibrated for N₂ is 24 Torr. At an indicated pressure of 50 Torr, the true pressure of argon is considerably above atmospheric pressure. Thus if the indicated pressure is not accurately converted to true pressure, it is possible to overpressure your system. Overpressure may cause glassware such as ionization gauges to shatter dangerously and if high enough may cause metal parts to rupture thus damaging the system and possibly injuring personnel. See Section 6 for proper use of conversion data.

It is strongly recommended that a pressure relief valve be installed in the system should the possibility of exceeding 1000 Torr (1333 mbar) exist.

High Indicated Pressure

For some gases, be aware the indicated pressure will be higher than the true pressure. For example, at a true pressure of 9 Torr for helium the indicated pressure on a Series 275 gauge calibrated for N₂ is 760 Torr. The safe way to operate the gauge is to properly use accurate conversion data. See Section 6 for proper use of conversion data.

Electrical

Before connecting your controller to a power source, be sure that the source is compatible with power requirements for the controller.

Electrical Power Requirements

A.C. Frequency: 48 to 62 Hz
Power consumption: 10W nominal
Line Voltage: 115V models: 105 to 125 volts
230V models: 210 to 250 volts

Connect the controller only to a 3-wire grounded receptacle. Do not bypass the ground connection. Have only qualified service personnel trained in electrical safety precautions service your controller. Completely disconnect equipment from all power sources before servicing equipment.

115V models are supplied with a standard NEMA 5-15P 3-wire plug. 230V models are supplied with a Western European Dual Grounding CEE(7)-VII plug. If the plug supplied with your controller is not compatible with your power source, the plug may be removed and replaced with a suitable 3-wire grounded plug. It is important that the following color code be followed when replacing the power plug to maintain electrical safety. DO NOT OPERATE THE INSTRUMENT UNGROUNDED because even a minor circuit malfunction could result in dangerous voltages being applied to exposed metal surfaces.

Brown or Black: AC line (hot)	Blue or White: AC neutral	Green or Green/Yellow: Earth Ground
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Chemical

Cleaning solvents, such as trichloroethylene, perchloroethylene, toluene and acetone produce fumes that are toxic and/or flammable. Use only in areas well ventilated to the outdoors and away from electronic equipment, open flames, or other potential ignition sources.

Sensor Failure

If the gauge tube becomes disconnected from the controller or if the sensor wire in the gauge tube fails, the controller will indicate beyond 1000 Torr or mbar and the process controls will be inactivated. The recorder output will be greater than 9 volts. If the tube is unplugged from a powered controller, there may be an instantaneous (0 to 0.2 seconds) drop in the pressure indication before the failsafe takes over, and the process control relays could activate for this brief time, depending on the order in which the tube pins break contact. When reconnecting a gauge tube which is at vacuum to the controller, the AC power to the controller should be removed to prevent damage to the sensor.

Tube Contamination

The calibration of the gauge will be seriously affected by any gas which will attack the gold plated sensor and could result in overpressurizing the system. Two primary gases in this category are mercury vapor and fluorine.

SECTION 3
INSTALLATION INSTRUCTIONS

8.18.1.15

Receiving Inspection

Domestic Shipments

Inspect all material received for shipping damage.

Confirm that your shipment includes all material and options ordered. If materials are missing or damaged the carrier that made the delivery must be notified within 15 days of delivery in accordance with Interstate Commerce regulations in order to file a valid claim with the carrier. Any damaged material including all containers and packing should be held for carrier inspection. Contact our Customer Service Department, 5675 East Arapahoe Avenue, Boulder, Colorado 80303, (303) 443-7660 if your shipment is not correct for reasons other than shipping damage.

International Shipments

Inspect all material received for shipping damage. Confirm that your shipment includes all material and options ordered. If items are missing or damaged the carrier making delivery to the customs broker must be notified within 15 days of delivery.

Example:

If an airfreight forwarder handles the shipment and their agent delivers the shipment to customs the claim must be filed with the airfreight forwarder.

If an airfreight forwarder delivers the shipment to a specific airline and the airline delivers the shipment to customs the claim must be filed with the airline, not the freight forwarder.

Any damaged material including all containers and packaging should be held for carrier inspection. Contact our Customer Service Department, 5675 East Arapahoe Avenue, Boulder, Colorado 80303, U.S.A. Telex 045 791 GPVAC Bldr or telephone (303) 443-7660 if your shipment is not correct for reasons other than shipping damage.

Important Precautions for Gauge Tube Installation

The following precautions in the use and installation of the Catalog No. 275 071 and 275 154 gauge tube must be observed.

1. The gauge tube should be installed with the port oriented vertically downward to insure that no system condensates or other liquids collect in the gauge tube. The gauge tube axis must be horizontal if it is to be used at pressures above 1 Torr or 1 mbar. Although the gauge tube will read correctly below 1 Torr (1 mbar) when mounted in any position, erroneous readings will result at pressures above 1 Torr (1 mbar) if the tube axis is not horizontal.
2. Do not use a compression mount (quick connect) for attaching the gauge tube to the system in applications resulting in positive pressures in the gauge tube. Positive pressures might blow the tube out of a compression fitting and damage equipment and injure personnel. Pipe thread or flange mounting systems should be used for positive pressure applications. In any case, the absolute pressure in the tube should not exceed 1000 Torr or 1333 mbar.
3. Do not perform electrical continuity tests on the tube with instruments applying voltages in excess of 1 volt when the tube is at vacuum, or 5 volts when at atmospheric pressure. Exceeding these voltages will damage the sensing element.

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4. Do not connect a powered up controller to a gauge tube which is at vacuum. A voltage surge may result which could damage the sensor.
5. Keep the tube clean. Do not remove the mounting port cover until you are ready to install the tube.
6. Do not mount the gauge tube in a manner such that deposition of process vapors, upon the internal surfaces of the gauge tube, may occur through line-of-sight access to the interior of the gauge tube.
7. Do not install the gauge tube where high amplitudes of vibration are present. Excessive vibration will cause forced convection at high pressure giving erroneous readings.
8. Do not bake the gauge tube to temperatures exceeding 150°C.
9. Do not install the gauge tubes where they will be subject to corrosive gases such as mercury vapor or fluorine which will attack the gold plated sensor.
10. For greatest accuracy and repeatability the gauge tube should be located in a stable room temperature environment.

Gauge Tube Construction

The transducer is a Pirani gauge providing rapid response, six-decades of pressure transduction, stable calibration, and good accuracy. The Pirani sensing element, R1 of the schematic of Fig. 3-1, is one leg of a Wheatstone Bridge. A temperature compensating network, R2, forms the second leg of the bridge. The temperature sensitive component of this network is mounted inside the gauge tube envelope with the sensor. All other resistors of the bridge are mounted upon the exterior electrical feedthru pins of the gauge tube and are protected from damage by the bakeable blue plastic trim cover. Pin designations are marked on the trim cover. Pin 4 serves as an electrical terminal for construction of the compensating network, R2, but no connection is made therefrom to the controller.

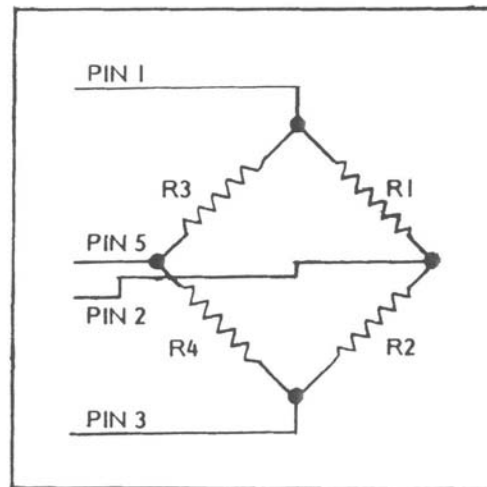


FIG. 3-1 GAUGE TUBE SCHEMATIC

All materials have been chosen for ultra high vacuum service, corrosion resistance and bakeability to 150°C. The gauge tube envelope is type 304 stainless steel. All metallic joints in the envelope are TIG welded. No solder is used within the envelope. The following materials are exposed to the vacuum: Type 304 stainless steel, Carpenter Alloy 52, Kovar⁽¹⁾, Kapton⁽²⁾ gold plated tungsten and borosilicate glass. The blue trim cover is molded of Polysulfone thermoplastic suitable for service to 150°C.

1. Trademark of Carpenter Technology
2. Trademark of DuPont

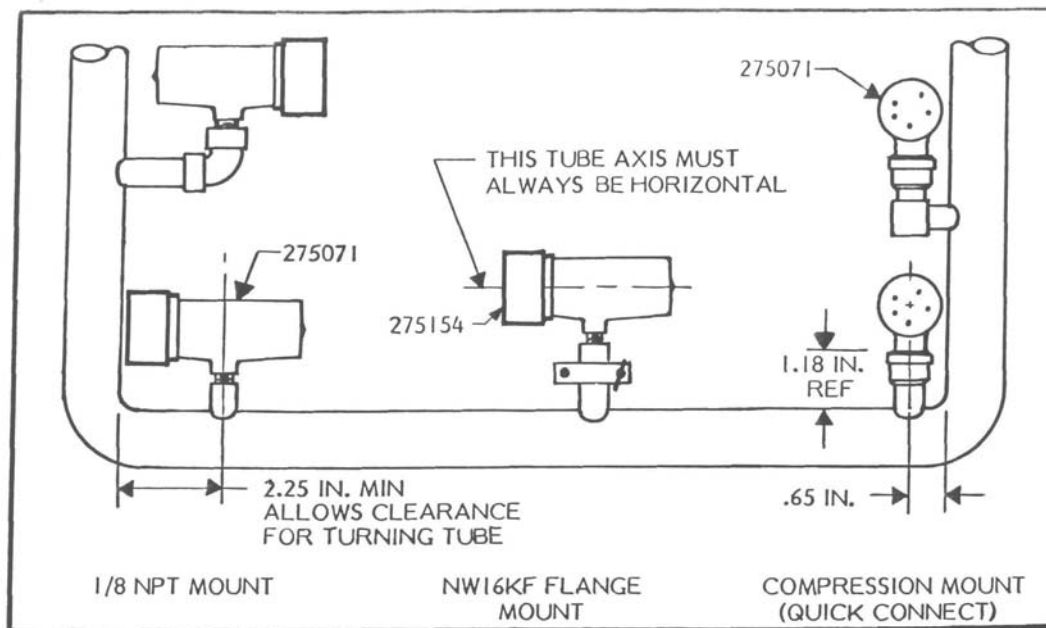


FIG. 3-2 GAUGE TUBE MOUNTING

Gauge Tube Orientation

It is important to consider the orientation of the gauge tube if accurate readings above 1 Torr or 1 mbar are necessary to prevent overpressure or for other reasons.

Below 1 Torr (or 1 mbar): The gauge tube will operate and accurately read pressures below 1 Torr (1 mbar) when mounted in any orientation. Above 1 Torr (or 1 mbar): The gauge tube will accurately read pressures above 1 Torr (1 mbar) only when mounted with its axis horizontal, preferably with the port pointing vertically downward, as shown in Fig. 3-2. It is valuable to point the port downward to facilitate the removal of condensation and other contaminants.

Installation

Mounting clearance dimensions are shown in Fig. 3-2.

Both of the 90° mounting options are dimensioned to provide the proper mounting clearance.

1. Compression Mount (Quick Connect)

Do not use for positive pressure applications.

The gauge tube port is designed to fit a standard 1/2 in. compression (quick disconnect) mount such as the Cajon Co. Ultra-Torr® fittings.

Remove the caplug from the gauge tube port, insert the gauge tube port into the compression fitting and finger tighten the press ring. If a seal is not achieved it is likely due to extreme cleanliness of the O-ring. A light film of vacuum grease such as Apiezon⁽³⁾ will insure sealing and is normally preferable to the use of pliers or pipe wrench to further tighten the press ring. You may point the electrical pins of the gauge tube anywhere you wish in a 360 degree horizontal circle for optimum routing of the gauge tube cable.

3. Trademark of James G. Biddle Co.

2. 1/8 NPT Mount

The threads on the gauge tube port will fit a standard 1/8 NPT female fitting. Wrap the threads of the gauge tube port with Teflon[®] tape and screw these threads into the system fitting hand tight. Do not use any wrench or tool. The gauge tube body functions adequately as its own wrench. Tighten only sufficiently to achieve a seal. When the threads have been tightened to the point where a seal is just achieved, about one-half turn additional tightening is all that can be gained without overstressing the tube port. Be very careful in tightening so as not to damage the feedthrough pins projecting from the blue trim cover.

3. NW16KF Flange Mount

The gauge tube supplied with gauge systems designed to operate on 230 VAC are equipped with an adapter for size NW16KF flange mounting. This adapter can be removed to facilitate compression mounting or 1/8 NPT mounting as shown above. Also, the adapter can be reused in the event a 275 071 tube is purchased to replace the 275 154 tube. The KF mounting system requires an O-ring and centering ring to be placed between the mating flanges. The flanges are then held together with the aluminum flange clamp by tightening the wing nut. Maximum pressure for this style mounting system is 1000 Torr or 1333 mbar absolute.

Cleaning

When the fine sensor wire is so contaminated with oil or other films that its emissivity or its diameter is appreciably altered, a change of calibration will result. Cleaning with trichloroethylene, perchloroethylene, toluene, or Acetone is possible but it must be done very carefully so as not to damage the sensor. CAUTION: The fumes from any of these solvents can be dangerous to your health if inhaled and they should be used in well ventilated areas exhausted to the outdoors. Acetone and toluene are highly flammable and should be used away from open flame or electrical equipment. Hold the gauge tube with the main body horizontal and the port projecting upward at an angle of 45° and slowly fill it with solvent. As it becomes nearly full, turn the port exactly vertical and fill completely. Let the solvent stand in the gauge tube for at least ten minutes. Do not shake the tube. If only partially filled, liquid forces on the sensor during shaking can become large enough to affect the transducer calibration. If the tube is completely filled shaking is not helpful. After flushing one or more times carefully pour out the solvent so that air may enter smoothly during pouring. Rotate the tube slowly and tip end to end so that all of the solvent drains out. Then allow the tube to dry overnight with port vertically downward and uncapped. Be certain no solvent odor remains before reinstalling gauge tube on system.

Controller Installation Instructions and Precautions

The controller may be used free-standing on desk or laboratory bench. When panel mounting is desired follow these steps in order.

1. Provide an opening in your panel 92mm (3.625 in.) square. Any of four standard panel thicknesses, 1/8 in., 3/16 in., 3mm and 4mm can be accommodated by the panel thickness adjustment. Note that you must have a minimum 220mm (8.65 in.) of space behind your panel to provide adequate cable and connector clearance at the rear of the enclosure. PRECAUTION - Each Series 275 controller dissipates approximately 10 watts inside its enclosure. Sufficient ventilation openings are provided in the enclosure to prevent the internal temperature rising above 70°C with natural convection cooling. It is important that the effectiveness of these openings not be impaired by mounting too close to adjacent instruments.

Trademark of DuPont

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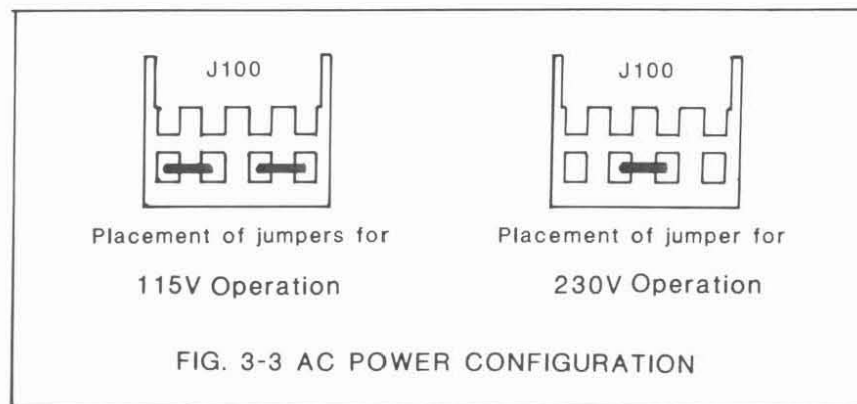
2. If controller outputs are required, open the blue enclosure connector of the cable assembly by removing the two screws. Remove one connector shell half only, leaving the other half bound to the cables by the nylon strain reliefs. Save all the small blue plugs that are freed when one-half of the shell is removed. You will need one or more to close unused openings when reassembling the connector. Use 18 or 20 AWG stranded wire. Use care to strip only 3/8 in. (10mm) of wire so that free strands cannot protrude through the external connector openings. Connect to the proper output pins using the table below:

<u>Pin(s)</u>	<u>Function</u>
D & 4	Process Control No. 1 relay common
E & 5	Process Control No. 1 relay normally open
F & 6	Process Control No. 1 relay normally closed
H & 7	Process Control No. 2 relay common
J & 8	Process Control No. 2 relay normally open
K & 9	Process Control No. 2 relay normally closed
L & 10	Chassis Ground
M	Recorder Output
N	Recorder Return

Route the added wires through the desired cable openings in the connector shell. Install nylon strain reliefs, supplied, in the same manner as those factory installed. Replace the small blue plugs in the unused cable openings. Place the spare blue plugs inside the connector shell for future use. Replace the connector shell half and the screws and nuts that hold the two halves together. Check the connector to see that no bare wires or strands are exposed which could cause an electrical shock hazard.

3. Determine the thickness of your mounting panel. The panel thickness adjustment is factory set for 1/8 in. (3.2mm) thick panels. If your panel is other than 1/8 in. thick remove the electronics module from the enclosure by inserting a 9/64 in. Allen wrench in the jack screw. Turn counter-clockwise, approximately 25 to 30 turns. Remove the panel mounting clips from the enclosure by sliding them forward, reset them for your panel thickness and reinsert them. If your panel is thicker than 3/16 in. (4.8mm) the panel adjustment can be modified by filing or grinding away enough of the rearward bearing surface of the adjustment to allow the panel-contacting portion of the adjustment to engage the panel.
4. Plug the enclosure connector into the enclosure. Using the two 4-40 x 1 in. screws provided in the cable assembly package, bolt the connector to the enclosure. **PRECAUTION:** When properly installed, both the brass jack screw nut insert at the front opening of the enclosure and the gauge cable connector will be at the bottom. Note the keying inside the enclosure connector; note the keying on the rear contactor edge of the printed circuit board; make sure the enclosure connector is correctly oriented to match up these keys. On newer units the connector shell is keyed to the case instead.

5. With the enclosure connector correctly attached to the enclosure, pass the cables through the opening in your panel. Press the enclosure into the panel opening, jack screw nut insert at bottom, until the rear face of the enclosure bezel is against your panel. The panel mounting clips should then snap outward behind the panel to lock the enclosure to the panel. Press on the interior surface of the mounting clips to insure that they snap fully outward behind the panel.
6. Your controller is configured and labeled for either 115VAC or 230VAC power depending on the particular catalog number. This can be reconfigured if desired by changing the plug-in jumpers and fuse as per Fig. 3-3. Be sure to change the labeling if this is done. J100 is located on the main board next to the fuse holder.
7. Align the printed circuit board with the lowermost slots in the enclosure. Push the electronic module into the enclosure until the jack screw hits the jack screw insert. Turn the jack screw clockwise until the electronic module seats against the enclosure. **CAUTION:** Do not overtorque the jack screw. If the electronic module appears to bind, stop and correct the cause before proceeding.
8. Connect the tube connector to the gauge tube.



9. Plug the power cord into a 3-wire grounded receptacle. Do not operate the instrument ungrounded because even a minor circuit malfunction may result in dangerous voltages being applied to exposed metal surfaces. The controller should now display the system pressure.
10. As a safety check before using, determine that your instrument reads the local atmospheric pressure correctly to within the accuracy of the instrument. Open the system to atmosphere and compare the indicated reading with the reading of an accurate barometer. Accurate barometric pressure information is usually readily available from government weather bureaus. If the indicated reading does not agree with the local atmospheric pressure, adjust the ATM potentiometer as described in Section 5.